oppoſite ſide; for I could plainly obſerve a difference afterward, if I neglected to mind both theſe circumſtances, or indeed either of them *.

XXVII. *A Deſcription of a Contrivance for meaſuring ſmall* Angles, *by Mr.* John Dollond; *communicated by Mr.* J. Short, *F. R. S.*

Read May 10, 1753.

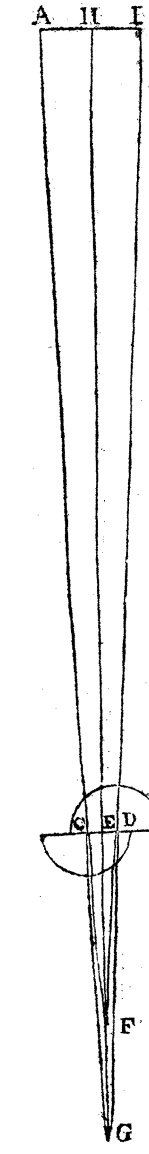
LET an object-glaſs, of any convenient focal length (being truly ground and well center'd) be divided into two equal parts or ſegments, by cutting it ſtrait through the center; and let a piece of machinery be ſo contriv'd, as to hold theſe two ſegments in the ſame poſition to each other, as they ſtood in before they were cut aſunder; and to be capable at the ſame time of drawing them to different diſtances from that poſition, in the manner, as is repreſented in the figure.

Each of theſe ſegments will form a diſtinct image of any object, to which they are directed; differing in nothing from that, which might have been made by the whole glaſs before it was cut, except in brightneſs. And while theſe ſegments are held in their original poſition, the images will coincide, and become one ſingle image as at firſt; but, in proportion as they

* Dr. Smith, in his Complete Syſtem of Optics, publiſhed in 1738, has deſcribed a very accurate and ready method of centering object-glaſſes, which was always uſed by the late Mr. George Graham, from whom the doctor had it.

they are drawn off from that ſituation, the images will ſeparate more or leſs, according to the diſtance they are drawn to. By this means the images of two different objects, or of different parts of the ſame object, not very far from each other, may be brought to a contact or coincidence at the focus: and this coincidence may be view'd to a very great nicety with a proper eye-glaſs.

The meaſure of the angle ſubtended by the two objects, whoſe images are thus brought to a coincidence, depends upon three things: Firſt, a careful obſervation of the coincidence of the images: Secondly, an exact meaſure of the diſtance, which the glaſſes are drawn out to from that ſituation, which makes the image ſingle: And, laſtly, a true knowlege of the focal diſtance of the glaſs. How the angle is to be found from theſe meaſures, and how it may likewiſe be come at, by viewing two land-objects at a convenient diſtance, will be ſhewn hereafter in the explanation of the figure. It is eaſy to underſtand, in the mean time, that the angle will be meaſur'd with more accuracy, in proportion to the length of the glaſs, which is uſed for that purpoſe; but the difficulty of managing long teleſcopes is no leſs apparent. Therefore the moſt practicable method of uſing this micrometer to advantage, is, to apply the divided object-glaſs to the object-end of a reflecting teleſcope: for, as the apertures of theſe ſort of teleſcopes are large in proportion to their lengths, they will admit of very long glaſſes; nor will the meaſures be any way affected by the metals or glaſſes, which the reflector is compoſed of: and the angles will be found in the ſame manner, as though the images were view'd with a



ſingle eye-glaſs, in the manner of a common refracting aſtronomical teleſcope; but with this advantage, that, as the images will be exhibited larger and diſtincter by the reflecting teleſcope; and as every part thereof will be much more manageable than a long refracting teleſcope; ſo the contact or coincidence of the images will be more accurately obſerv'd.

It would be however unneceſſary now, as well as improper, to ſay much about the advantages of this method above thoſe, which have hitherto been put in practice; becauſe, as a machine is now making for this purpoſe, the experiments, which will ſhortly be tried, will be more convincing, as well as more intelligible, than any thing that might be offer'd at preſent.

Explanation of the Figure.

The two ſemicircles repreſent the two ſegments of the object-glaſs, whoſe centers *C* and *D* are drawn off to the diſtance *CD*, and the points *A* and *B* are two objects, or different parts of the ſame object; therefore the lines *ACG* and *BDG* repreſent two rays that paſs thro' the centers or poles of the ſegments, and are therefore not at all refracted, but go ſtrait through to *G*, where they interſect; and *G* being the reſpective focus to the diſtance of the objects from the glaſs, the two images will coincide at that point. It appears from the figure, that $AB : CD :: GH : GE$; and from a common proportion in optics, $GH : GE :: HE : EF$. Therefore, $AB : CD :: HE : EF$; *F* being the focus of parallel rays; and conſequently

conſequently the angles *AEB* and *CFD* are equal. That is, the angle ſubtended by the diſtance of the centers of the ſegments from the diſtance of the focus of parallel rays is equal to the angle ſubtended by the diſtance between the objects *A* and *B* from the end of the teleſcope.

XXVIII. *A Letter to Sir* Peter Thompſon, *Knt: F.R.S. containing Experiments on the* Copper Springs *in* Wicklow *in* Ireland, *and Obſervations thereon, by* John Bond, *M. D.*

SIR,

Read May 10, 1753. YOU may remember I had the honour of ſpending an evening with you in June laſt, and happen'd to mention a ſpring in the county of Wicklow in Ireland, which was ſuppoſed to have the ſurpriſing quality of changing iron into copper. But your conſtant love of truth, and ſtrong averſion to vulgar errors, made you doubt the fact, which, at that time, I could only affirm on the report, which prevailed among the curious in that country. You then propoſed ſeveral judicious queries, and ſeemed deſirous of being further informed concerning it, which raiſed my curioſity to take the firſt opportunity of inquiring more particularly into the foundation of that marvellous account.

Having ſoon afterwards occaſion to go to Dublin, I went to the ſpring, which is from thence about thirty-eight miles, and made ſeveral experiments on the